

REMARKS

In the present response no claims are amended or canceled. Claims 1-12 remain pending in the present application.

In the Office Action mailed August 25, 2004, claims 1, 3-7, and 9-12 were rejected under 35 USC § 103(a) as being unpatentable over Sunkara et al (U.S. Patent No. 6,235,948) in view of Haas et al. (U.S. Patent No. 6,297,408). Applicants respectfully traverse the rejection.

Claim 1 and its dependent rejected claims 3-6 provide a process for producing 1,3-propanediol that includes the steps of a) forming an aqueous solution of 3-hydroxypropanal; b) hydrogenating the 3-hydroxypropanal to form a first crude 1,3-propanediol mixture containing 1,3-propanediol, water, and MW 132 cyclic acetal; c) distilling the first crude 1,3-propanediol mixture to remove water and low boiling impurities and form a second crude 1,3-propanediol mixture; d) contacting the second crude 1,3 propanediol mixture with an acid form cationic exchange resin at a temperature of from about 50°C to about 150°C to convert the MW 132 cyclic acetal to more volatile cyclic acetals and/or other degradation products; and e) separating the more volatile cyclic acetals and/or degradation products from 1,3-propanediol by distillation or gas stripping. Of particular note for this response, claim 6 further includes the step of distilling the 1,3-propanediol to separate the 1,3-propanediol from high boiling impurities formed as a result of step d (of claim 1).

Claim 7, an independent claim, tracks the language of claim 1 except that in step d) the second crude 1,3-propanediol mixture is contacted with an acidic zeolite at a temperature of from about 70 to about 250°C to convert the MW 132 cyclic acetal to more volatile cyclic acetals and/or degradation products instead of being contacted with an acid form ion exchange resin at about 50°C to about 150°C. Again, of particular note for this response, claim 12 provides the process of claim 7 further comprising the step of distilling the 1,3-propanediol to separate the 1,3-propanediol from high boiling impurities formed as a result of step d.

Sunkara et al provides a two-step process for purifying 1,3-propanediol to remove color-forming impurities. In a first step, the 1,3-propanediol is contacted with an acid catalyst at 100°C to 160°C to convert color precursors and other impurities to colored and uncolored derivatives that are easily separable from 1,3-propanediol. In the

second step, the catalyst is removed and the remaining mixture is distilled under reduced pressure to collect purified 1,3-propanediol as the distillate, leaving the colored impurities and other impurities in the flask (col. 3, lines 13-21).

Haas et al merely discloses that MW 132 cyclic acetal is formed during the preparation of 1,3-propanediol by hydroformylation of 3-hydroxypropanal.

The purpose of the present invention, as claimed in claims 1-12, is set forth in the second full paragraph on page 2 of the specification. Succinctly, MW 132 acetal of propanediol is an undesired byproduct of the hydroformylation and hydrogenation reactions used to form 1,3-propanediol that cannot easily be separated by simple distillation from 1,3-propanediol because it has similar volatility to 1,3-propanediol. The invention provides a means to separate MW 132 acetal of propanediol by degrading it into more volatile components that then can be separated from the 1,3-propanediol by simple distillation.

The present invention as claimed in claims 1-12 is not obvious from Sunkara et al in light of Haas et al, because one skilled in the art would not learn from Sunkara et al or Haas et al how to remove MW 132 cyclic acetal and/or its degradation products from 1,3-propanediol. According to the process disclosed by Sunkara et al, the MW 132 cyclic acetal would likely be degraded by contacting the 1,3-propanediol with an acid catalyst at a temperature of from 100°C-160°C. The volatile degradation products of MW 132 cyclic acetal, however, would not be separated from the 1,3-propanediol by the distillation step performed after contacting the 1,3-propanediol with an acid catalyst at 100°C-160°C.

As taught in the present invention, contact of MW 132 cyclic acetal with an acid form cationic exchange resin or an acidic zeolite at elevated temperatures causes the conversion of MW 132 cyclic acetal to the more volatile 2-ethylene-1,3-dioxane cyclic acetal (EDCA) (see page 5, last paragraph, and page 6, first paragraph, of specification). The more volatile EDCA and other volatile degradation products of MW132 cyclic acetal would be separated with 1,3-propanediol in the process of Sunkara et al since 1) the degradation products are more volatile than MW 132 cyclic acetal; 2) MW 132 cyclic acetal has a volatility similar to 1,3-propanediol; and 3) Sunkara et al teaches collecting the 1,3-propanediol as a distillate from colored impurities and other impurities, which are left in the distillation flask. In short, the degradation products of MW 132 cyclic acetal would be collected with the 1,3-

propanediol in the Sunkara et al distillate because the degradation products are even more volatile than 1,3-propanediol, and would not be left in the distillation flask with the color impurities.

Claim 1, claim 7, and their respective dependent claims provide a step of separating the more volatile cyclic acetals and/or degradation products derived by contacting MW 132 cyclic acetal with an acid form cationic exchange resin or an acidic zeolite at 50°C-150°C or 70°C to 250°C, respectively, from 1,3-propanediol by distillation or gas stripping. These more volatile cyclic acetals and/or degradation products are never separated from 1,3-propanediol in the process of Sunkara et al. The only distillation taught by Sunkara et al is to remove 1,3-propanediol from less volatile impurities such as color impurities. Claims 6 and 12 of the present invention provide a similar step after the more volatile degradation products from MW 132 cyclic acetal have been removed from the 1,3 propanediol, e.g., the 1,3-propanediol is distilled to separate the 1,3-propanediol from high boiling impurities.

One skilled in the art, therefore, would not find the processes claimed in claims 1, 3-7, and 9-12 obvious from Sunkara et al. in light of Haas et al.

In the Office Action of August 25, 2004, claims 2 and 8 were objected to as being dependent on a rejected base claim, but were deemed allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicants submit that claims 2 and 8 are allowable in their present form since their respective independent claims 1 and 7 are allowable over the cited art as discussed above.

In light of the above, Applicants request allowance of all the pending claims 1-12.

Respectfully submitted,

JOSEPH BROUN POWELL,
PAUL RICHARD WEIDER
and GLENN CHARLES COMPLIN

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By: 

Richard B. Taylor Reg. No. 37,248
Shell Oil Company
P.O. Box 2463
Houston, TX 77252-2463
(713) 241-3558